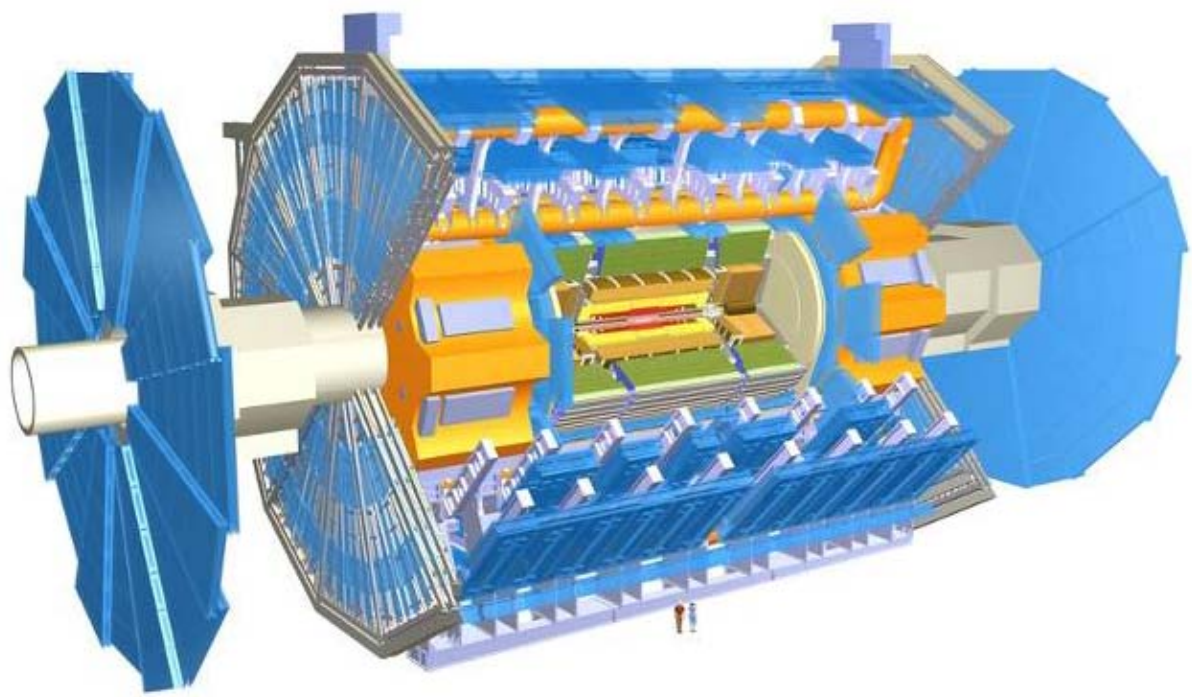
Commissioning of the ATLAS detector and combined test beam results

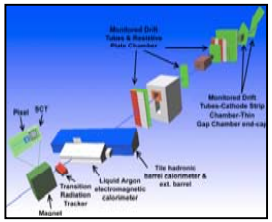
P. Perrodo, LAPP-IN2P3-CNRS/CERN,
on behalf of the ATLAS collaboration



Xth Pisa Meeting, May 21-27 2006, Isola d'Elba

ATLAS road map

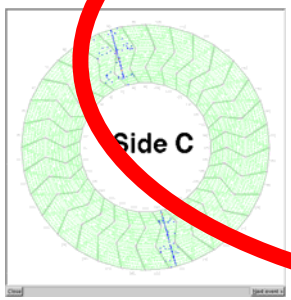
2005 2006 2007 2008

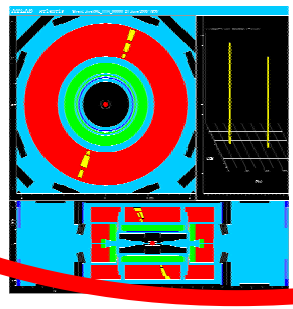


Combined test beam
(1% of ATLAS)

Detector installation

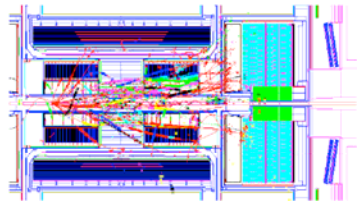
Integration, from detector to off-line
cosmic runs





Global cosmic run

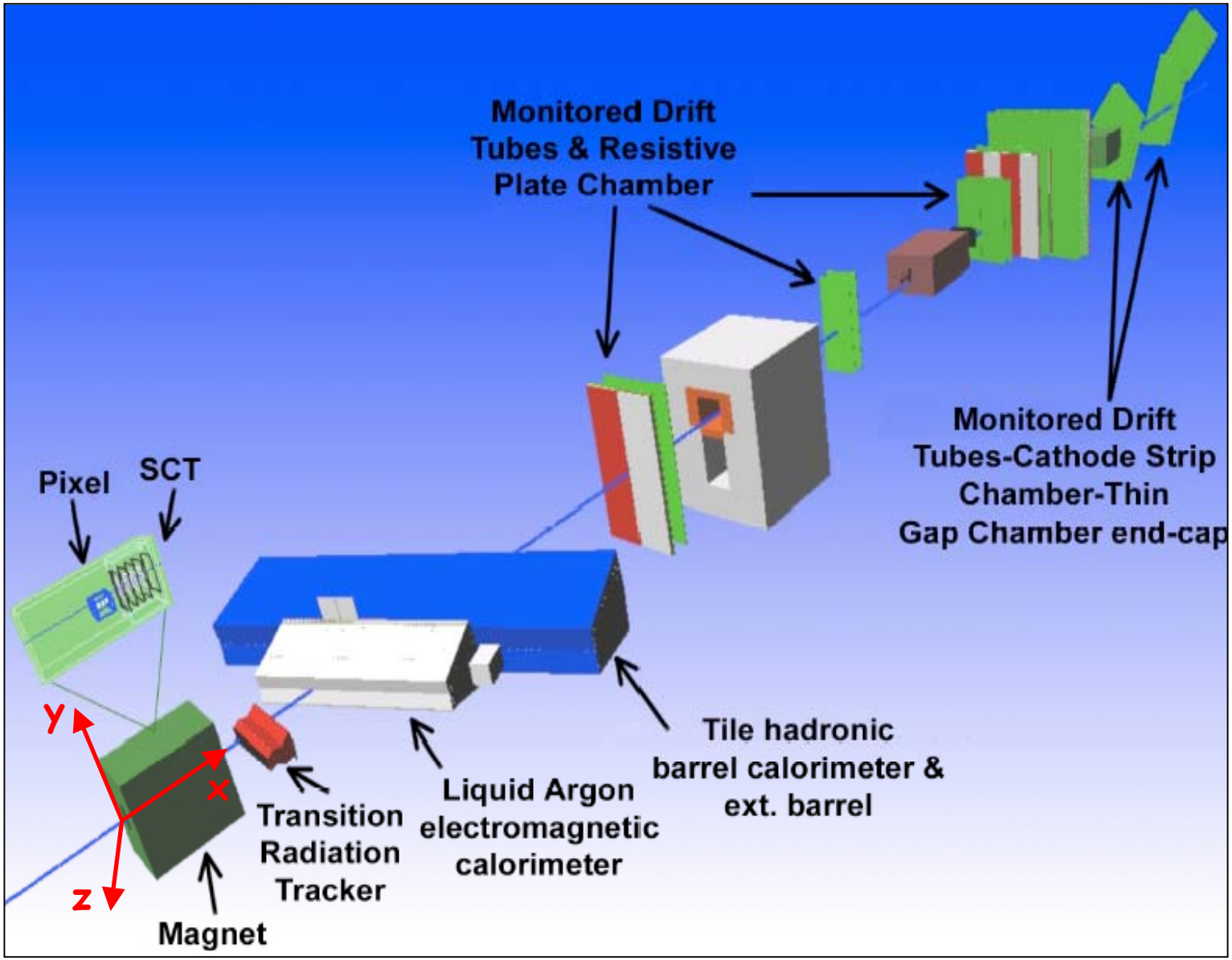
First beams



Installed today

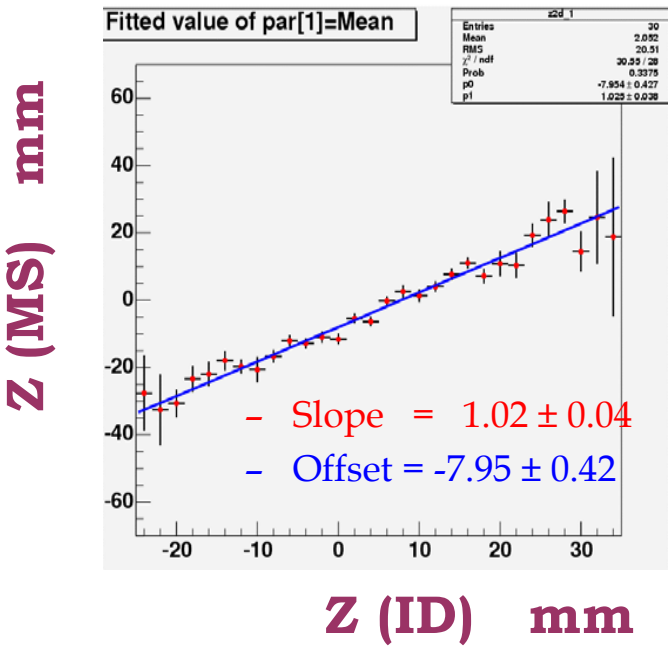
- Liquid argon and TILES calorimeters:
  - All in the cavern, Barrel LARG cryostat is cold,
  - Barrel Front end electronics all here, expect the power supplies
  - A small fraction of the readout is possible yet
  - Will grow in size with more power supplies
- Muon spectrometer (barrel and forward)
  - Chambers under installation.
  - Very small fraction of the readout available
  - Forward wheels coming next
- Inner detector (SCT+TRT, pixel later)
  - SCT+TRT barrel integrated, tested on surface
  - Good fraction of the readout present already used.
  - Then long installation in the cavern
- Magnets:
  - Solenoid: ~cold
  - Barrel toroid: pumping
  - Endcap toroid: end Sept. 06

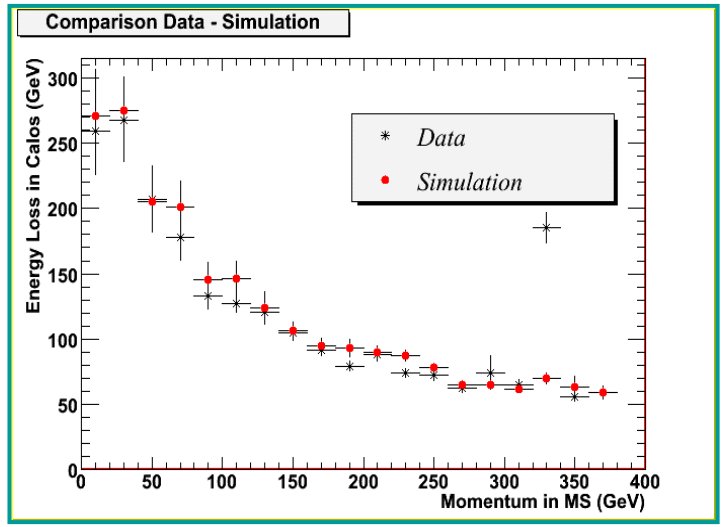
ATLAS combined test beam



Test beam results with muons

- **Tracking Muon Spec.- Inner Detector**
  - Back extrapolation of a muon track to the inner detector (Pixel + SCT)
  - Validation of the reconstruction software
  - Alignment procedure
  - Measure of the tracking performances
- **Performances Calo.-Muon Spec.**
  - Muons (~300 GeV) with a Bremsstrahlung in the Calorimeters
  - Validation of the reconstruction software
  - Evaluate inter-calibration Calo – Muon spectrometer
  - Quality of the simulation (Geant 4)

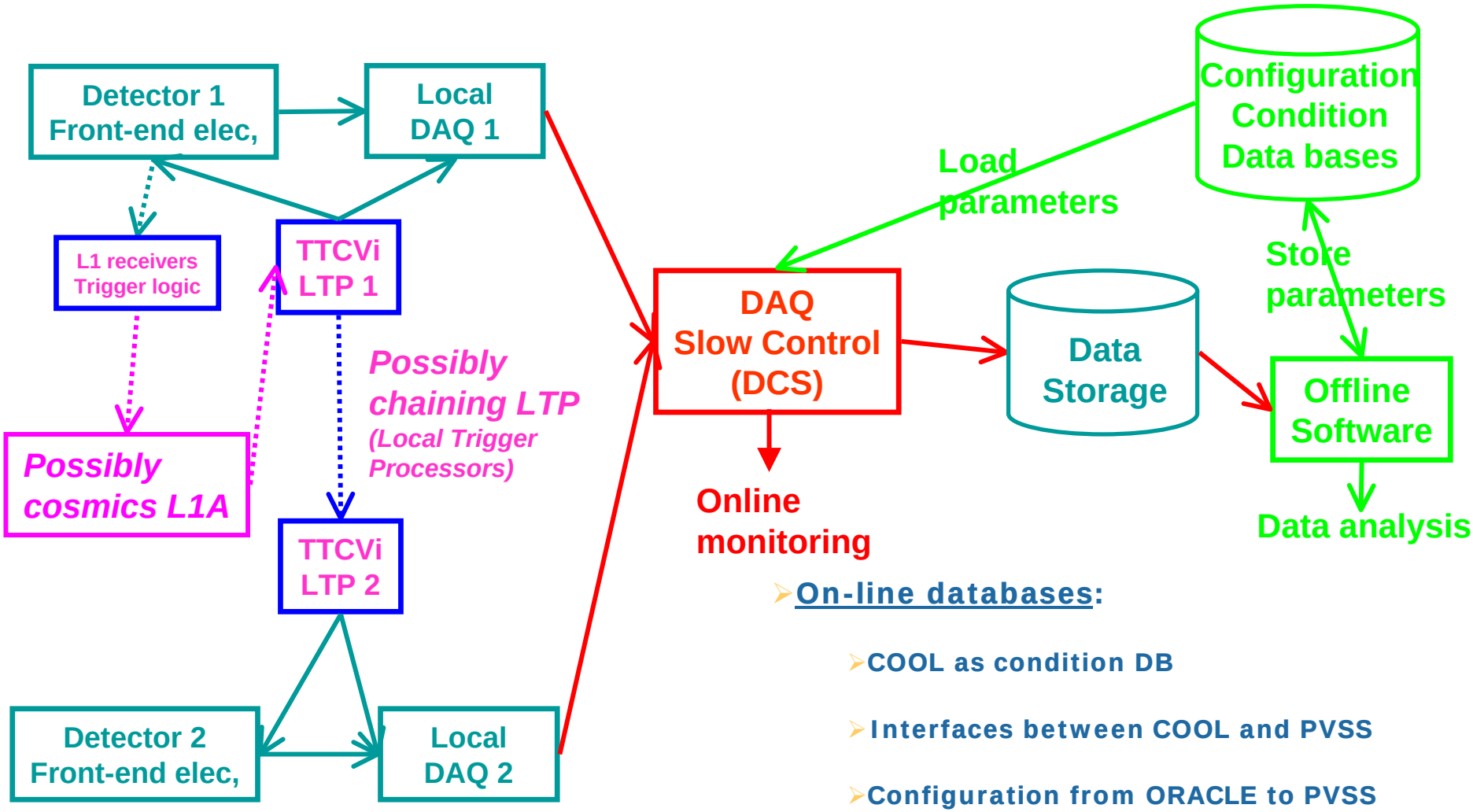




Detector integration

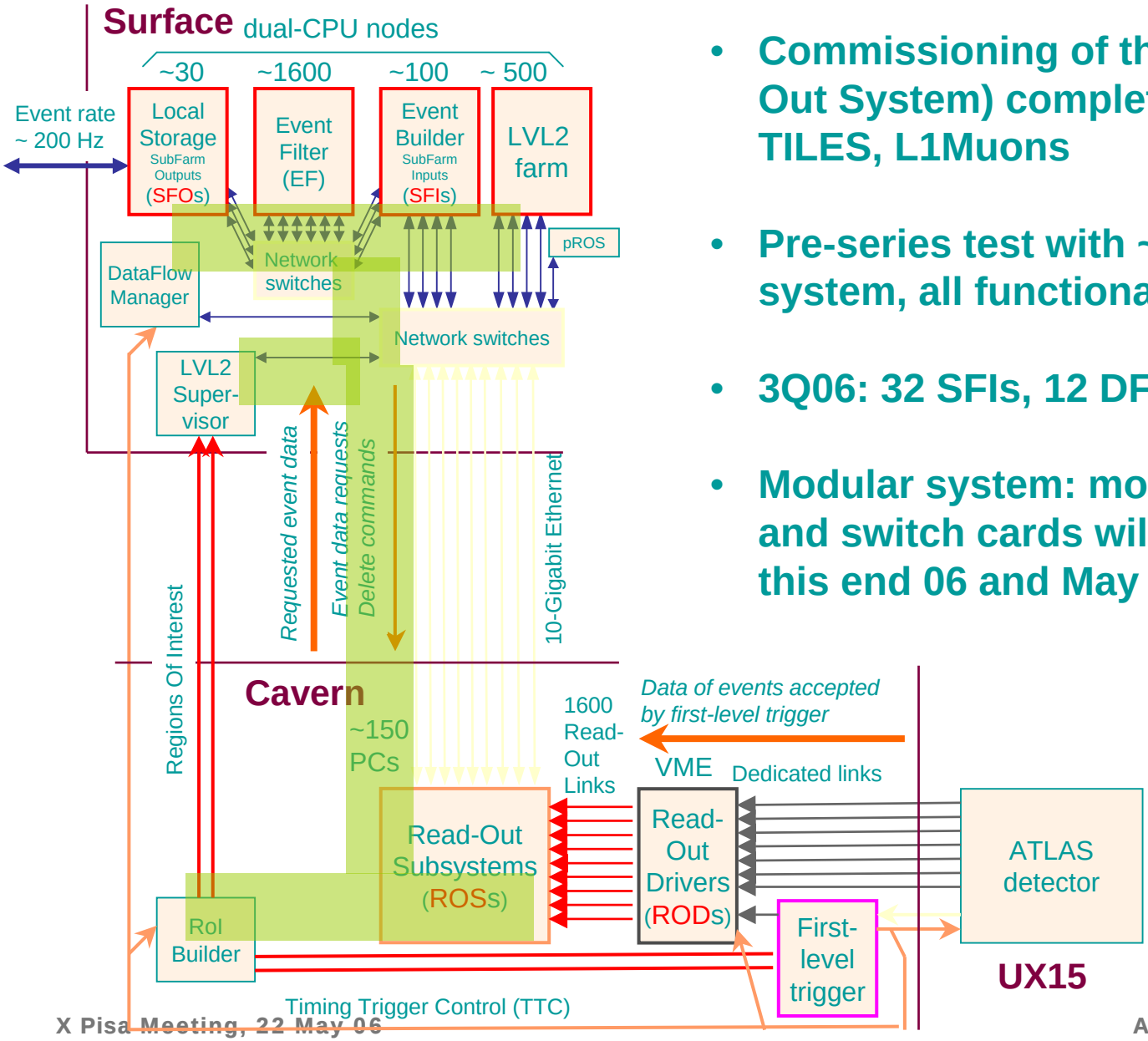
- **Exercise various combinations of ATLAS sub-systems**:
  - *Detectors, DAQ and online databases*. Idem with DCS (Slow ctrl.)
  - *Calorimeters and the calorimeter trigger*. Calibration, integration of the trigger.
  - *Magnets*:
    - **Barrel toroid tests. Exercise all installed detectors. Functional tests. Cosmic runs.**
    - **Solenoid mapping. Exercise the calorimeters electronics.**
- **Functional tests**: test the performances: operational, new errors, recovery procedures, stability of the data taking, calibration procedures
- **Run with cosmics**:
  - Data taking, on line monitoring, full analysis chain exercised. Detector study:bad channels.
- Repeat the exercise when the readout system grows in size.

Detector schematics



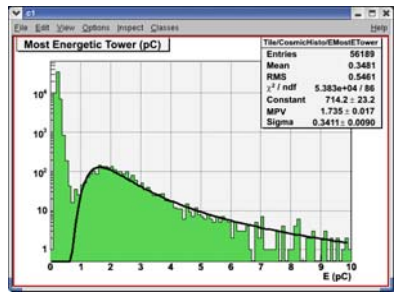
- **On-line databases:**
  - **COOL as condition DB**
  - **Interfaces between COOL and PVSS**
  - **Configuration from ORACLE to PVSS**
  - **Various choices for configuration/conditions according to the features of the detectors.**

DAQ components

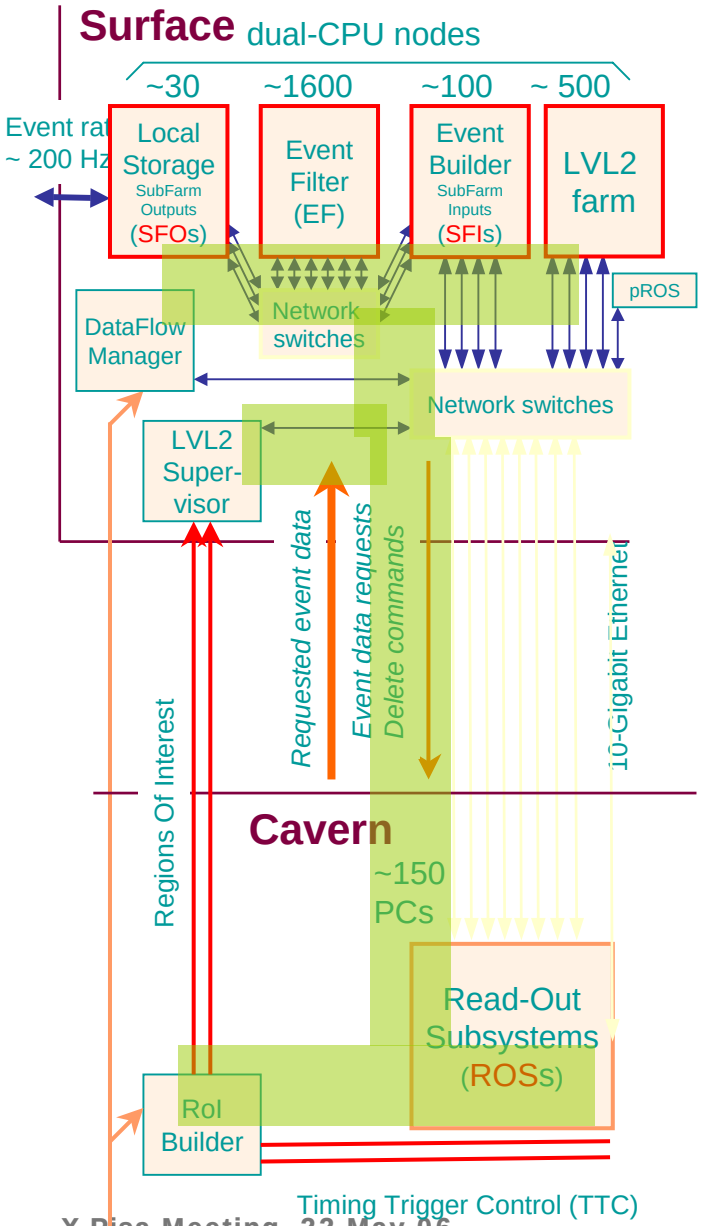


- **Commissioning of the 150 ROS (Read-Out System) completed this year: LARG, TILES, L1Muons**
- **Pre-series test with ~10 % of the full system, all functionalities present.**
- **3Q06: 32 SFIs, 12 DFMs, 2 L2SV, switch**
- **Modular system: more and more PCs and switch cards will arrive between this end 06 and May 2007**

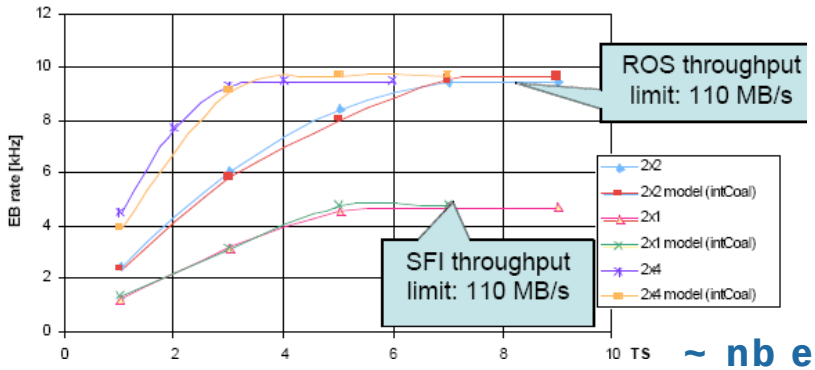
TILES+ DAQ HLT



DAQ pre series results

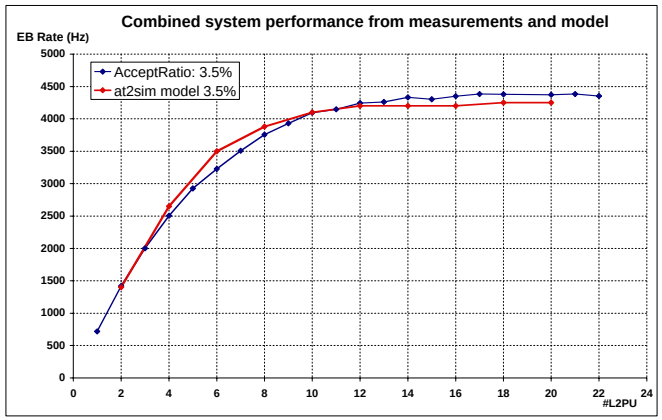


- **Event Builder only. Comparison pre-series with model in various configurations.**

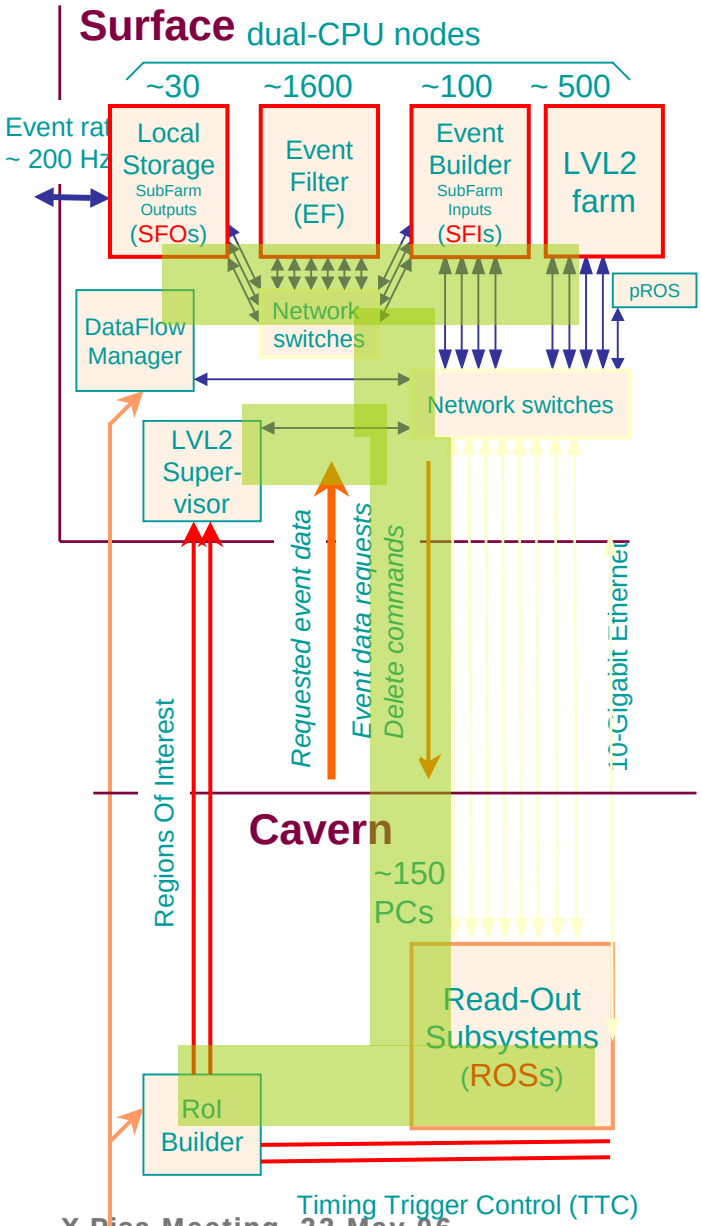


~ nb ev./s/SFI

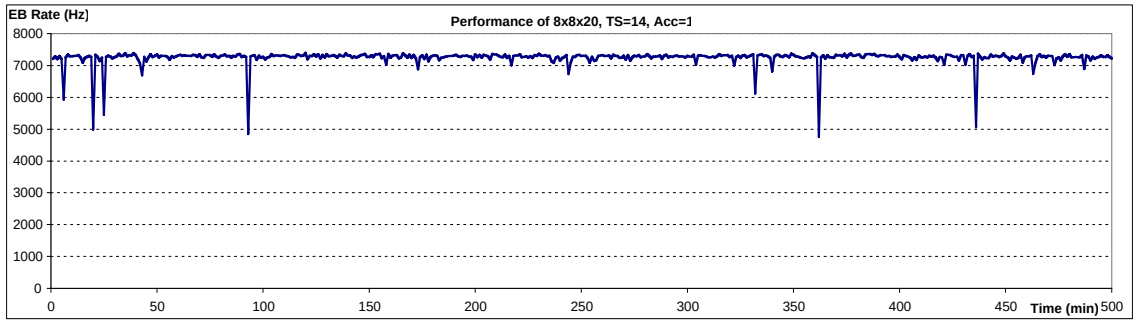
- **Event Builder + Level2. Dummy L2 algorithm. 8 ROS, 8 SFI. Comparison pre-series with model in various configurations.**



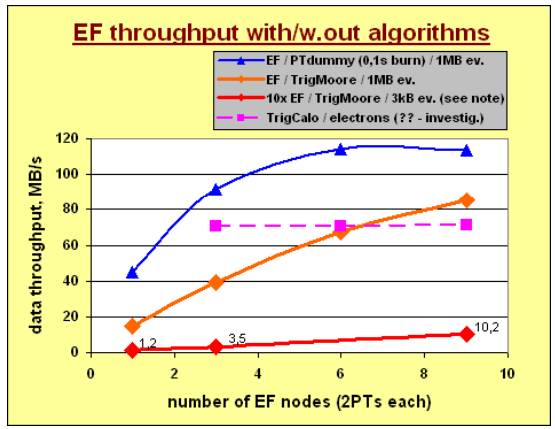
DAQ pre series results



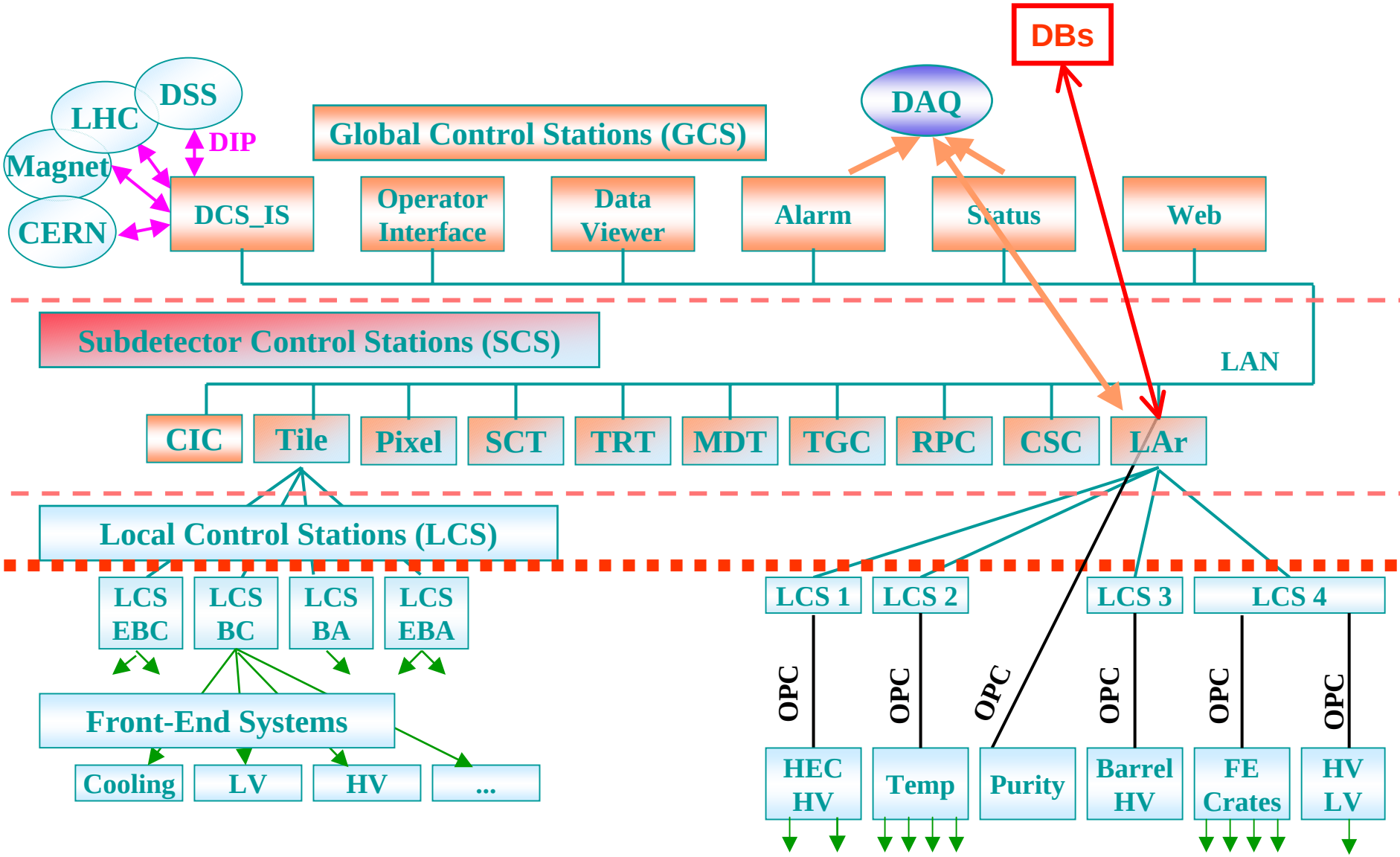
- **Long runs (->24hrs). 8 ROS, 8 SFI, 20 L2, dummy algorithms. Stability observed.**



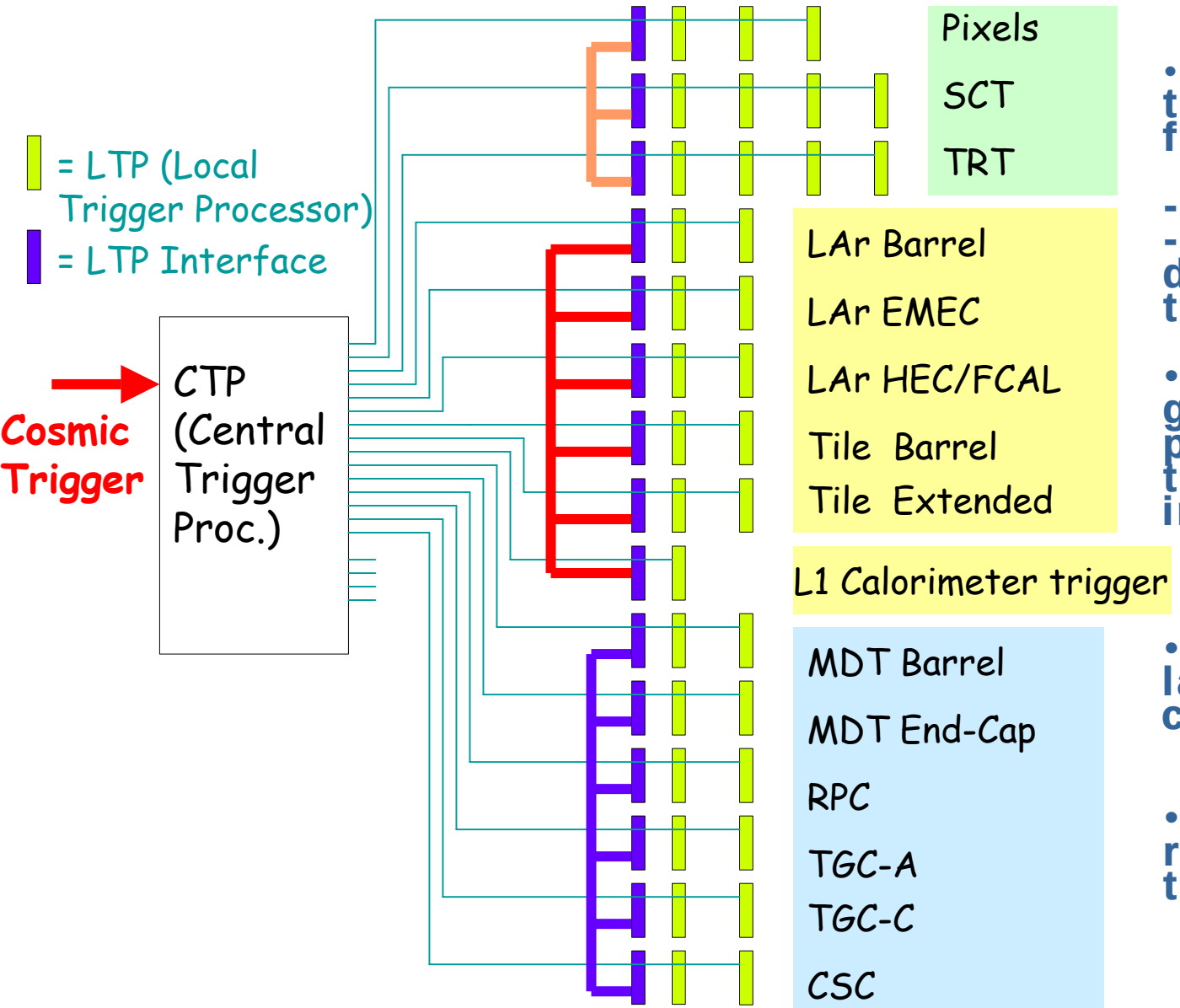
- **Test with Event Filter. Real algorithms (Online 10.0.06) with ROS emulation sending Geant events**



DCS components



Grouping of Sub-System Partitions



- Partitioning of the detector. Used for:

-Commissioning
-Calibration of the detectors during the LHC inter-fills

- Run independent groups of partitions thanks to a special interface board

- This provides a large flexibility for commissioning

- The CTP can receive cosmic trigger signals

Level 1 trigger

Calorimeter trigger

June 06: final RODs

July 06: ROiBuilder, HLT

Sept 06: CTP integration

Muon Barrel trigger

June 06: run with lower sector, CTP, HLT cosmics

Muon Endcap trigger

July 06: electronics for the TGC trigger (M1-C)

Sept 06: first final sector logic

June 06: ROS integration, ROiBuilder and RPC

MuCTPI

June 06: CTP in place

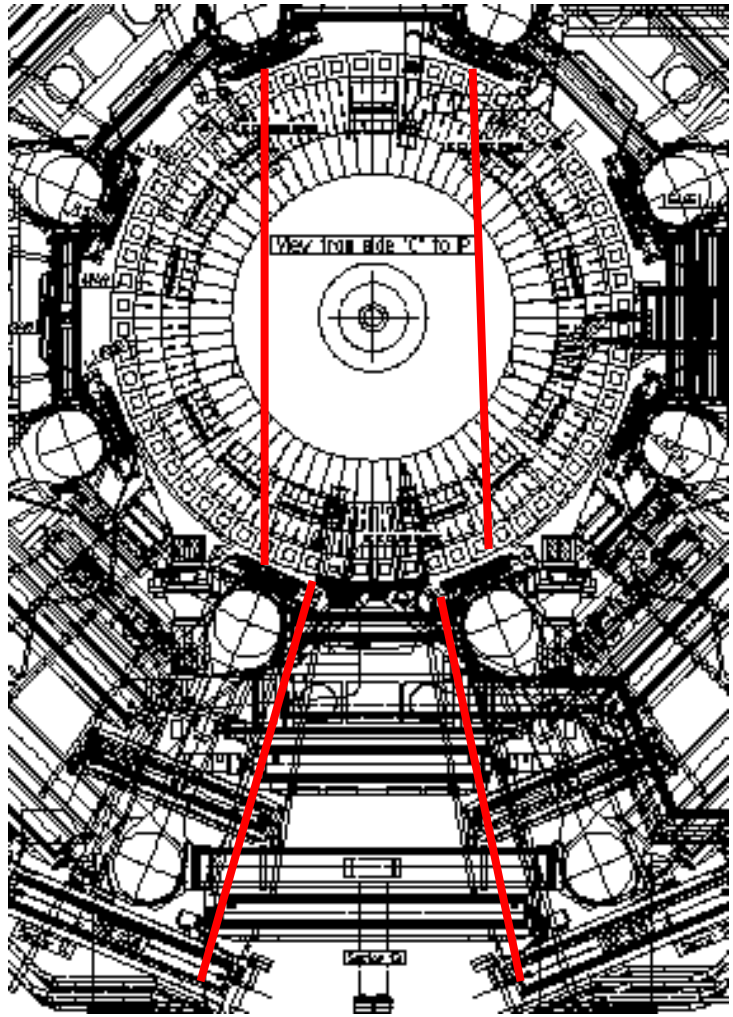
July 06: Conf databases, combined with RPCs, combined with HLT

Aug 06: Add thecalorimeters

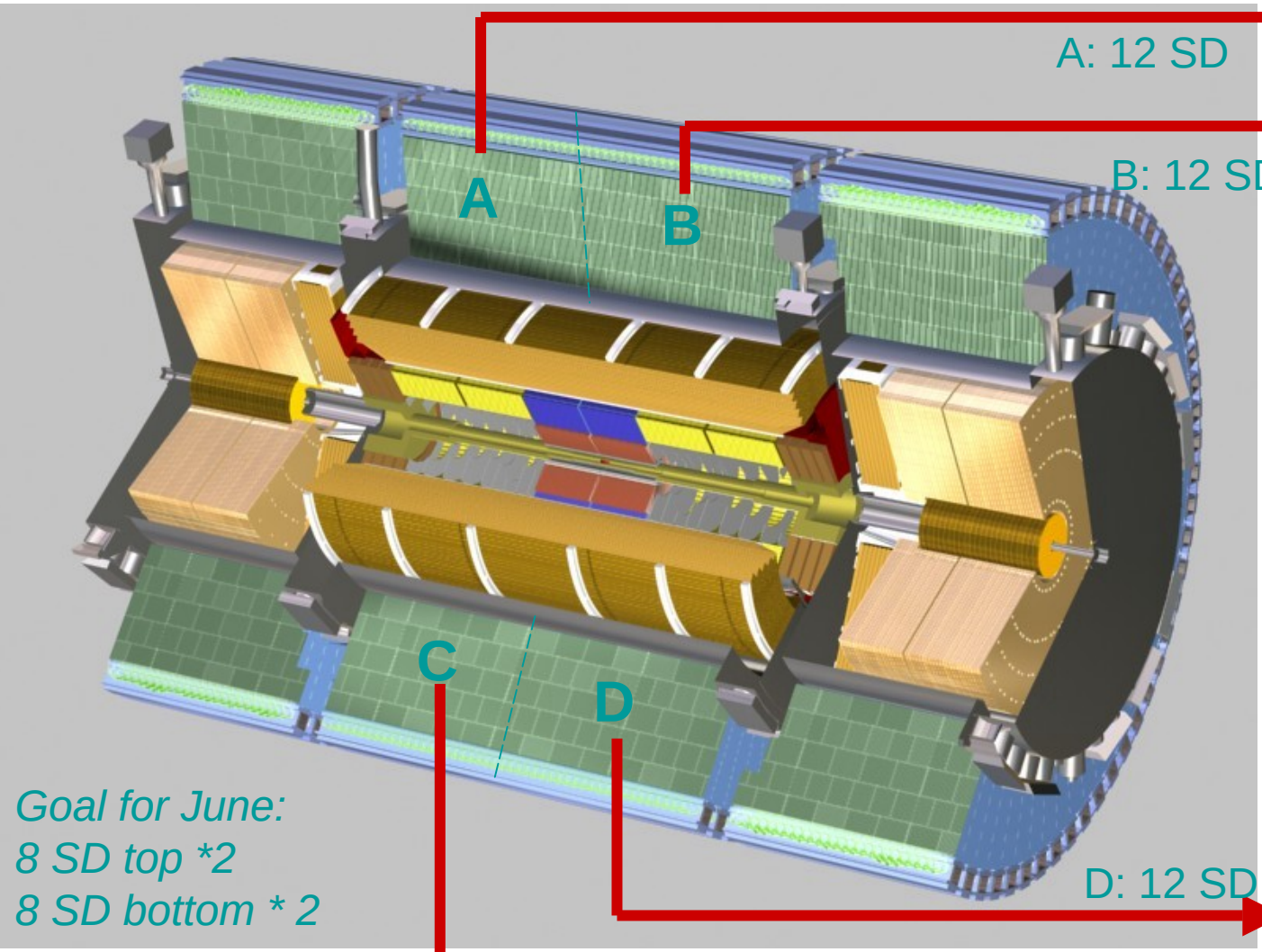
CTP

Cosmic runs

- **Exercise the full functionalities**:
  - Conf DB, Trigger, DAQ, Slow control, HLT, on-line monitoring, event display, control room, shifts
  - Full calibration procedures. Treatment of the bad channels
- **Detectors available**:
  - LARG barrel, TILES barrel (limited readout). L1CALO trigger
  - Muon spectrometer lower sector
- **Physics goals**
  - Amplitude inter calibration
  - Timing studies
  - Bad channels characterization



Cosmic trigger with Tiles calo.



A: 12 SD

B: 12 SD

D: 12 SD

C: 12 SD

1

2

3

4

Four Coinc. Boards

Estimate Rate < Hz

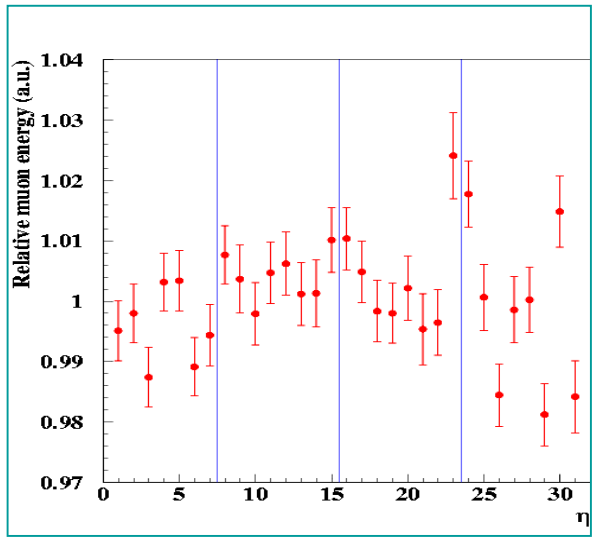
*(coinc. ~400 Hz * 100 ns ~ 1E-5)*

Goal for June:
*8 SD top *2*
*8 SD bottom * 2*

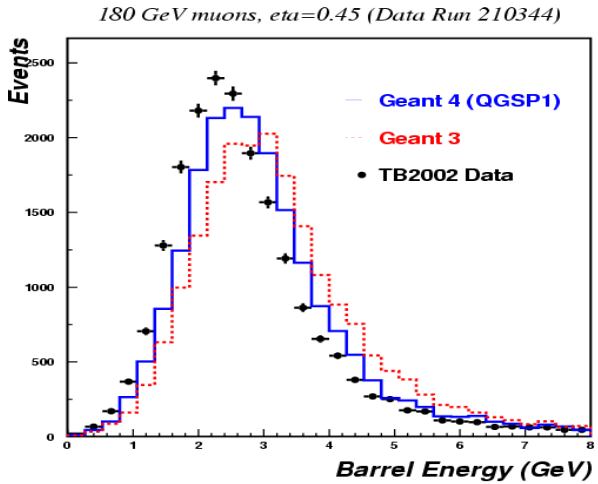
$$(A \cup B) \cap (C \cup D)$$

Cosmic runs

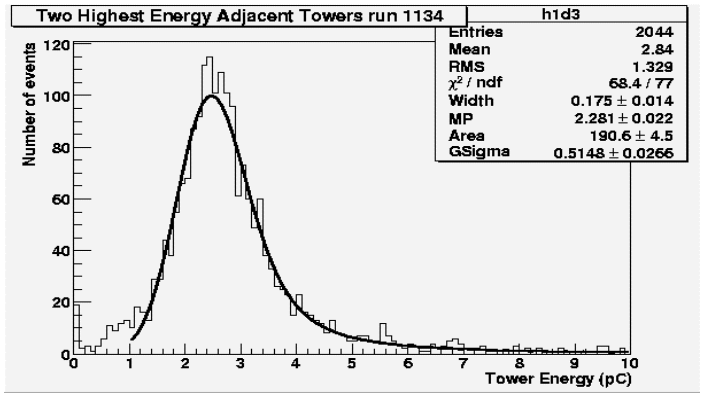
- **Internal LARG inter-calibration**
  - Amplitude vs η
  - Needs 40000 muons/cell for 0.5% precision
  - Rate 0.04(0.15 non projective) Hz
  - 100 muons/cell -> ~100 days of DAQ
  - But can understand timing at 0.6 ns



- **TILES response to MIP**
  - At the combined test beam



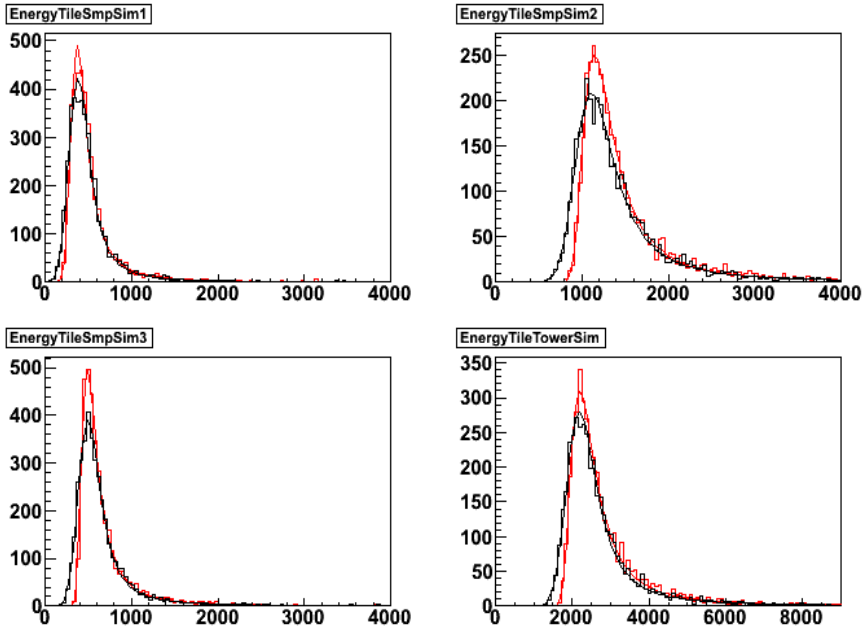
In the Cavern (LV power supplies different ->noise



Cosmic runs

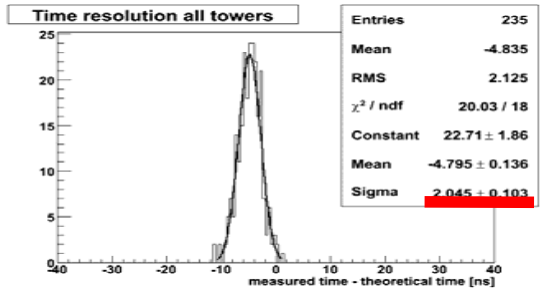
LARG-TILES inter-calibration

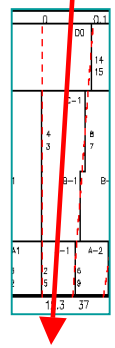
- Response to MIP at the combined test beam, compared to simulation, for layers and total
- 3% agreement



TILES timing

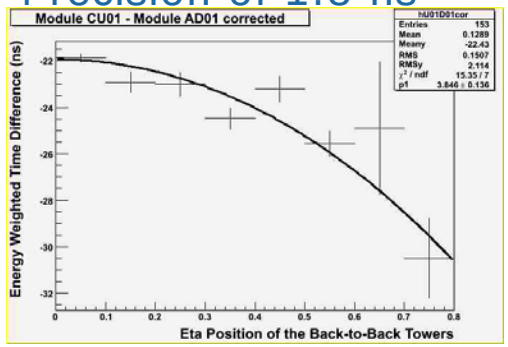
- From comparison of various cells
- Time resolution found of 1.7 ns





TILES time difference (top-bottom)

- After correction fits with the geometrical estimate
- Precision of 1.8 ns



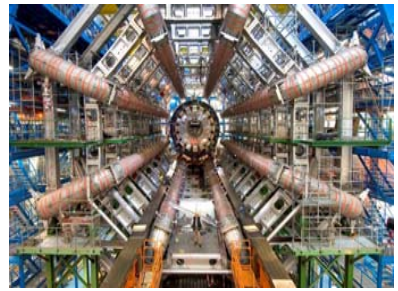
Some rates

- **TILES**
  - 1/16 of the barrel: 1GB/day
- **LARG**
  - Electronic calibration ramps (100,000 channels in the barrel): 5.2TB (transparent), 42GB (averaged locally in the LARG DAQ)
  - Calibration signals recording: 650 GB
- **Cosmics** at 10Hz
  - TILES: 1.4MB/s
  - LARG 15MB/s. Maximum recording 20 MB/s
- **Muons** (lower sector)
  - 20 Hz and 2kB/event
- **Autumn 06**:
  - end cap calorimeter. Need the Event Builder to take the data flow.

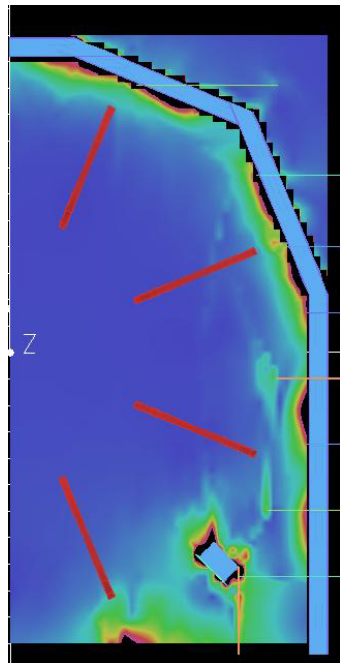
Barrel toroid test

- Test the BT as a separate object

run	Goal	Current [kA]	ramp time [hours]	total [hours]	recovery [days]
1	test at low current	5	0.3	3.9	--
2	test at 1/4 of full energy	10	0.7	2.9	--
3	test at 1/2 of full energy	15	1.0	3.6	--
4	test at 3/4 of full energy	18	1.3	3.5	--
5	test at full energy	20.5	1.4	3.8	--
6	fast dump low current	5	0.3	0.9	??
7	fast dump (quench)	15	1.0	1.3	??
8	steady state test	20.5	1.4	11.8	--



- Exercise everything already installed in presence of magnetic field
  - Infrastructure (LV, gas, cooling) already installed around the detector
  - Operate the Front-End electronics: LARG, TILES calorimeter, Barrel Muons (MDT, RPC) chambers
  - Muon spectrometer: Alignment system, precise measurement of the field (B at 1-2mT for BI at 4 10^{-3}), effect of the surrounding structures
  - Take cosmics with muon spec., TILES and LARG



- Similar issues for the solenoid mapping

Global cosmic run to first beams

- Toward a global cosmic run (spring 2007)
  - Integrate the detectors and systems as they come, when they grow in size, debug the full chain from shifts to data analysis.
  - Cosmics can be used for the barrel part. Use of cosmics for the end-caps is under investigation.

- Beam gas
  - can be used for for the end-caps: alignment, timing, inter-calibration.
  - Run at high L1 trigger rate with real events. DAQ challenge.

- Very first collisions: detector debugging and performances
  - With ~10-100 pb-1, ~ 10^4 Z->ee, Z-> $\mu\mu$, also tt->blν bjj,

  Trackers, Calorimeters, muon alignment, jet energy scale and b-tag

- A lot of work and fun is coming!

Thanks to: L. Chevalier, R. Nikolaidou, L. Pontecorvo, R. Teuscher, G. Unel, Th. Wengler